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ABSTRACT

The differential results obtained when the perceived exertion levels of 19 high-fit and 17 low-fit women were assessed according to Borg's Rating of Perceived Exertion Scale and magnitude estimation suggests that the RPE scaling procedures may be tapping a very select component of the perceptual process. These results do indicate that the scaling procedures traditionally utilized for the assessment of perceived exertion can have important implications for the generalizations advanced from the body of perception of effort research. Contrary to the theories based on previous research, however, new data suggests that the perceptual exponent of the low-fit group is not significantly higher than that of the high-fit subjects. This may be because the low-fit individuals are less perceptually discriminating than their high-fit counterparts.
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The Influence of Fitness and Selected Psychological Variables on Perceived Exertion

Patricia M. Mihevic

The majority of work in perceived exertion has employed Borg's (1962, 1970) rating of perceived exertion (RPE) scale as the assessment tool. Borg (1961a, 1961b, 1962) has also employed various psychophysical scaling procedures and demonstrated that perception of effort grows as a positively accelerating function with increasing stimulus intensities. The perceived exertion function has been described by a perceptual exponent of 1.6 with a general range of 1.4 to 1.8 (Borg, 1962). However, the value of the exponent obtained is a function of the form of the psychophysical power function employed. Since the psychophysical scaling procedures do not readily facilitate interindividual comparisons, the parsimony and versatility of the RPE scale have made it the measurement procedure of choice in most clinical and research endeavors.

It has been implicitly assumed in the perceived exertion literature that the RPE scale and psychophysical scaling procedures are tapping the same qualities underlying perception of effort. However, since the growth of perceived exertion is linear with the RPE scale and positively accelerating with psychophysical scaling procedures, it is reasonable to suggest that the influence of selected physiological parameters and psychological variables may differ as a function of the scaling procedures employed. In contrast, similar relationships for perception of effort with selected psychobiological constructs regardless of scaling method would provide convergent

validity support for the elaboration of the nomological network encompassing perceived exertion.

Perceived exertion measured by the RPE scale has been shown to be influenced by both physiological and psychological variables (Borg and Noble, 1974; Morgan, 1973). Morgan (1973) has demonstrated that state anxiety, trait anxiety, neuroticism, and depression influence perceived exertion for a magnitude estimation task as well as when the RPE scale is employed. In his study, however, the relationship between the psychological variables and number of errors in the magnitude estimation task was examined rather than the relationship between these variables and the perceptual exponent. In addition, perception of effort assessed with the RPE scale has been shown to be responsive to hypnotic suggestion (Morgan et al., 1973; Morgan et al., 1976) and a dissociative cognitive strategy (Morgan et al., in preparation). Teeghtsoonian (1977) has also demonstrated that the perceptual exponent is altered with fatigue.

The primary purpose of the present study was to examine the influence of fitness on perception of effort assessed with Borg's RPE scale and a magnitude estimation procedure. A secondary purpose was to evaluate the relationship of selected psychological states and traits with perceived exertion assessed by both methods.

METHOD

The Astrand-Rhyming bicycle test for prediction of maximal aerobic power (MAP) was employed to select a group

of high fit and low fit women from a larger group of volunteers. Standard informed consent procedures were employed. A predicted MAP equal to or greater than 50.00 ml/kg/min. was accepted as the criterion value for high fit Ss. Low fit Ss were selected on the basis of a predicted MAP equal to or less than 40.00 ml/kg/min. Four high fit and five low fit Ss were eliminated from the final data analysis on the basis of invalid psychological data. The 19 high fit Ss remaining had a mean predicted MAP of 55.81 ± 6.93 ml/kg/min. The predicted MAP of the 17 low fit Ss was 35.29 ± 13.60 ml/kg/min.

On a second testing day the S reported to the laboratory and first completed the following standardized psychological inventories: Spielberger State-Trait Anxiety Inventory (Spielberger et al., 1970), Profile of Mood States (McNair and Lorr, 1971), Somatic perception Questionnaire (Landry and Stern, 1971), and the Eysenck Personality Questionnaire (Eysenck and Eysenck, 1975). Following completion of the psychological inventories, the Ss cycled for two six minute periods separated by a five minute rest period and rated her perception of effort for each of five randomly ordered workloads.

For the magnitude estimation task, Ss pedalled at 60 rpm with a resistance of 600 kpm for two minutes. The S chose a number to represent her perception of effort at this standard with the understanding that perceived exertion at subsequent workloads would be evaluated in proportion to perception of effort at the standard workload. Workloads of 200, 400, 800, and 1000 kpm were then presented in random order for one

minute each. Heart rate was monitored throughout the exercise with a cardiograph and recorded on a Gilson physiological recorder during the last 15 seconds of each workload.

The workload order was identical for both the magnitude estimation task and the category ratings of perceived exertion (RPE). Subjects performed both rating tasks on the same day with task order and the presentation order of the last four workloads randomized across Ss. When rating their perception of effort with the RPE scale, Ss were instructed to evaluate their perceived exertion for each workload independently of the other workloads.

RESULTS

The mean ages for the high and low fit groups were 23.83 ± 3.26 years and 22.67 ± 3.48 years, respectively. Although the two groups differed significantly for MAP ($p \leq .01$) and body weight ($p \leq .05$), no differences between the two groups were observed for any of the psychological variables.

Heart rate responses at each workload for the two groups are presented in Figure 1. The heart rate response of the high fit group was significantly lower ($p \leq .01$) at all workloads. In contrast, the RPE values at each workload are remarkably similar for the high and low fit subjects. These results are presented in Figure 2. Bivariate correlations between RPE values at each workload and selected psychological variables were inconsistent and unimpressive for both groups.

The psychophysical functions obtained for the high and low fit groups are presented in Figure 3. The perceptual exponent for the high fit group, $1.33 \pm .43$, was significantly

higher ($p \leq .05$) than the $1.01 \pm .42$ value obtained for the low fit subjects. Heart rate responses during the magnitude estimation task were similar to those obtained for the RPE trial.

Bivariate correlations between selected psychological variables and the perceptual exponent for each group are presented in Table 1. Significant correlations of the perceptual exponent with tension ($r = .57$, $p \leq .05$) and vigor ($r = -.60$, $p \leq .01$) were observed for the high fit group. For these subjects, high levels of tension and low levels of psychic vigor were associated with a higher perceptual exponent. The low fit group was characterized by significant correlations between the perceptual exponent and extraversion ($r = .56$, $p \leq .05$), tension ($r = -.54$, $p \leq .05$), and depression ($r = -.56$, $p \leq .05$). For these subjects, high levels of extraversion and low levels of tension and depression were associated with a higher perceptual exponent. In general, the direction of the relationships differed for the two groups. A Z transformation comparison of the correlations for the two samples revealed that the correlations between the perceptual exponent and neuroticism, state anxiety, and vigor differed at the .05 level. Differences at the .01 level were observed for the correlations with tension and depression.

With the perceptual exponent as the dependent variable, the most relevant psychological variables as well as the mean heart rate across workloads for each group were combined in multiple regression analysis. These results are presented in Tables 2 and 3. For the high fit group, the combination of

vigor and tension was most important in accounting for variance in the perceptual exponent and yielded a significant multiple R of .66. Extraversion and tension were most important as contributors to the perceptual variance of the low fit group with a significant multiple R of .71.

DISCUSSION

The similarity of perceived exertion ratings for the two groups even though the low fit subjects were working significantly harder is consistent with reports by Morgan and his associates for male soldiers, wrestlers and distance runners (Morgan, 1977; Morgan and Pollock, 1977). It has been suggested by Morgan (1977) that the perceptual congruence in view of the physiological differences reflects a lack of veridical perception by the less physiologically capable individuals. In contrast, the different perceptual exponents for the two groups suggests that high and low fit individuals do indeed perceive absolute exercise intensities differently. However, theoretically, it would be expected that the growth of sensations underlying perception of effort would be more rapid for the low fit subjects. Thus, the perceptual exponent of the low fit group should be higher than that for the high fit subjects. Examination of the individual data revealed a possible explanation for this theoretical inconsistency. The low fit subjects were generally less able to discriminate among exercise intensities. That is, these subjects displayed a tendency to estimate the magnitude of two or more workloads similarly. These findings may also explain the close visual similarity of the psychophysical functions for the two groups

even though the exponents differed. Thus, these results suggest that low fit individuals may be less perceptually discriminating than their high fit counterparts.

The lack of significant relationships between perceptual ratings (RPE) and selected psychological variables is contrary to a report by Morgan (1973). Although male subjects were tested in Morgan's experiments, there is little evidence to suggest that men and women perceive exercise stress in a dissimilar manner. However, when perceived exertion was assessed with a magnitude estimation task, selected psychological variables did exert an influence on perception of effort. In this context, a state-trait model was most applicable to the low fit subjects, while the perceptual variance of the high fit subjects was best explained by a psychological state model. The importance of tension and psychic vigor to perception of effort for the high fit subjects is consonant with theoretical expectations. In contrast, the positive correlation of extraversion and the inverse relationship of tension with the perceptual exponent for the low fit subjects are contrary to theoretical expectations. The differential impact of these variables on the two samples is not readily explained since no differences were observed between the two groups for these variables at the outset.

The differential relationship of fitness and perceived exertion when the RPE scale and magnitude estimation are employed for assessment purposes suggests that the elaboration of theoretical propositions for perceived exertion is dependent on the scaling procedure employed. This suggestion is consonant

with the position supported by many perceptual psychologists (Stevens, 1971, 1974). Alternatively, since the perceptual exponent reflects the integration of responses over several workloads and the RPE values focus on discrete workloads, the sensations providing the input for the perceptual exponent may be more numerous or varied than that impinging on the subject for discrete RPE values. Consequently, the differential results may reflect differences in the variety and/or quantity of sensation information integrated to provide a perceptual evaluation.

In conclusion, the differential results obtained when perceived exertion is assessed with the RPE scale and magnitude estimation suggests that the two scaling procedures may be tapping different components of the perceptual process. These results do indicate that the scaling procedures employed for the assessment of perceived exertion can have important implications for the generalizations advanced from perception of effort research.

References

- Borg, G. Interindividual scaling and perception of muscular force. Kgl. Fysiogr. Sællsk. Lund Foerh., 1961a, 12, 117-125.
- Borg, G. Perceived exertion in relation to physical work load and pulse-rate. Kgl. Fysiogr. Sællsk. Lund Foerh., 1961b, 11, 105-115.
- Borg, G. Physical Performance and Perceived Exertion. Gleerup: Lund, Sweden, 1962.
- Borg, G. Perceived exertion as an indicator of somatic stress. Scand. Journal of Rehabilitation and Medicine, 1970, 2-3, 92-98.
- Borg, G. and Noble, B. Perceived exertion. In J. Wilmore (Ed.) Exercise and Sport Science Reviews, Vol. 2. New York: Academic Press, 1974.
- Eysenck, H.J. and Eysenck. S.B.G. Manual for the Eysenck Personality Questionnaire. San Diego: Educational and Industrial Testing Service, 1975.
- Landry, F.J. and Stern, R.M. Factor analysis of a somatic perception questionnaire. Journal of Psychosomatic Research, 1971 15, 179-181.
- McNair, D.M., Lorr, M. and Droppleman, L.F. Profile of Mood States Manual. San Diego: Educational and Industrial Testing Service, 1971.
- Morgan, W.P. Psychological factors influencing perceived exertion. Medicine and Science in Sports, 1973, 5, 97-103.
- Morgan, W.P. Perception of effort in selected samples of Olympic athletes and soldiers. In G. Borg (Ed.) Physical Work and Effort. New York: Pergamon Press, 1977.
- Morgan, W.P., Raven, P.B., Drinkwater, B.L. and Horvath, S.M. Perceptual and metabolic responsivity to standard bicycle ergometry following various hypnotic suggestions. International Journal of Clinical and Experimental Hypnosis, 1973, 21, 86-101.
- Morgan, W.P., Hirota, K., Weitz, G.A. and Balke, B. Hypnotic perturbation of perceived exertion: ventilatory consequences. American Journal of Clinical Hypnosis, 1976, 18, 182-189.
- Morgan, W.P. and Pollock, M.L. Psychologic characterization of the elite distance runner. Annals of the New York Academy of Sciences, 1977, 301, 382-403.
- Morgan, W.P., Horstman, D.H. and Cymerman, A. Psychoendocrine response to vigorous physical activity. In preparation.

Spielberger, C.D., Gorsuch, R.L. and Lushene, R.E. State-Trait Anxiety Inventory Manual. Palo Alto: Consulting Psychologists Press, 1970.

Stevens, S.S. Issues in psychophysical measurement. Psychological Review, 1971, 78, 426-449.

Stevens, S.S. Perceptual magnitude and its measurement. In E.C. Carterette and M.P. Friedman (Eds.) Handbook of Perception; Psychophysical Judgment and Measurement. New York: Academic Press, 1974.

Teghtsoonian, R., Teghtsoonian, M and Karlsson, J.G. The effects of fatigue on the perception of muscular effort. In G. Borg (Ed.) Physical Work and Effort. New York: Pergamon Press, 1977.

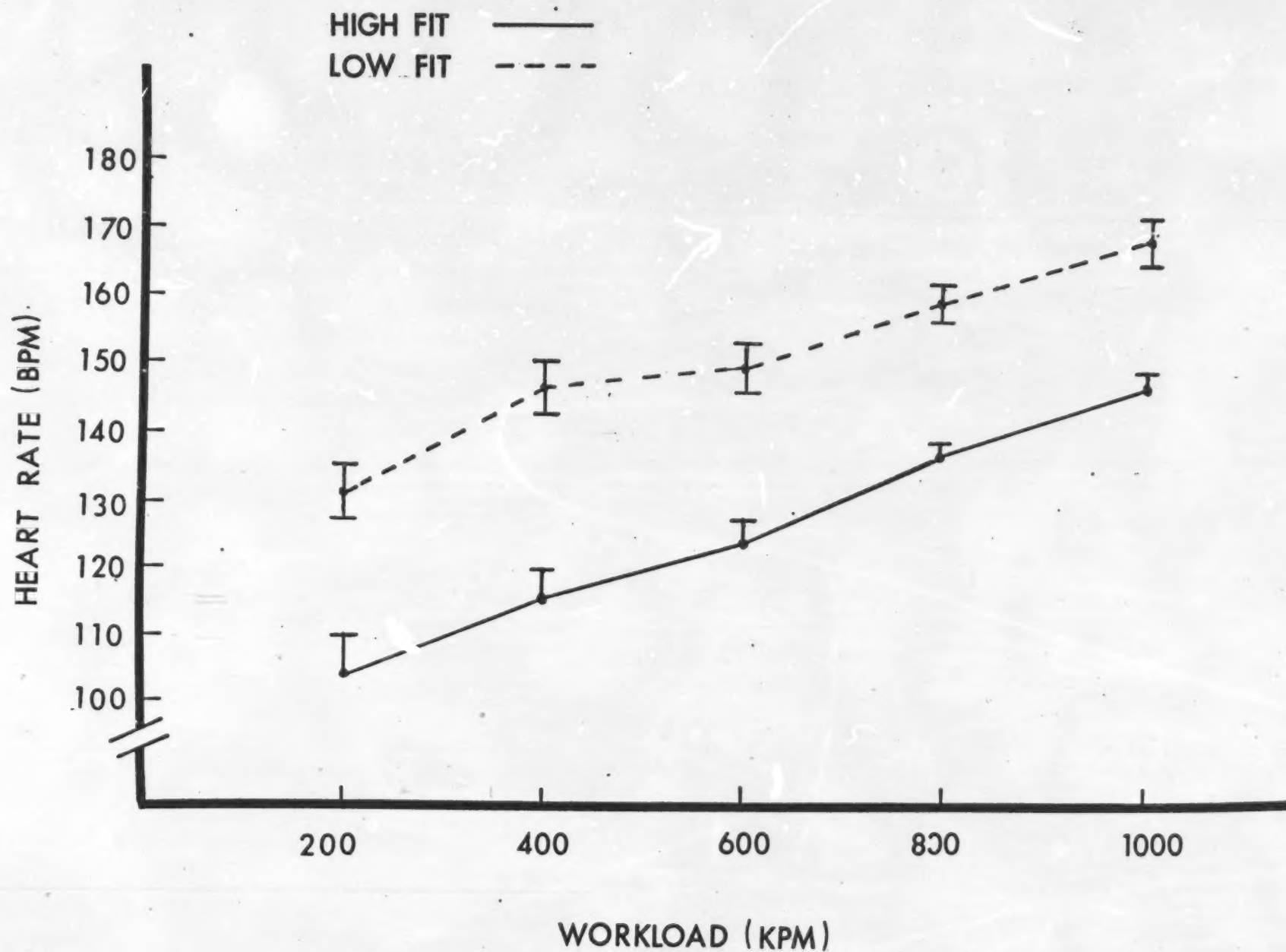


Figure 1. Heart rate at each submaximal workload for high and low fit subjects.

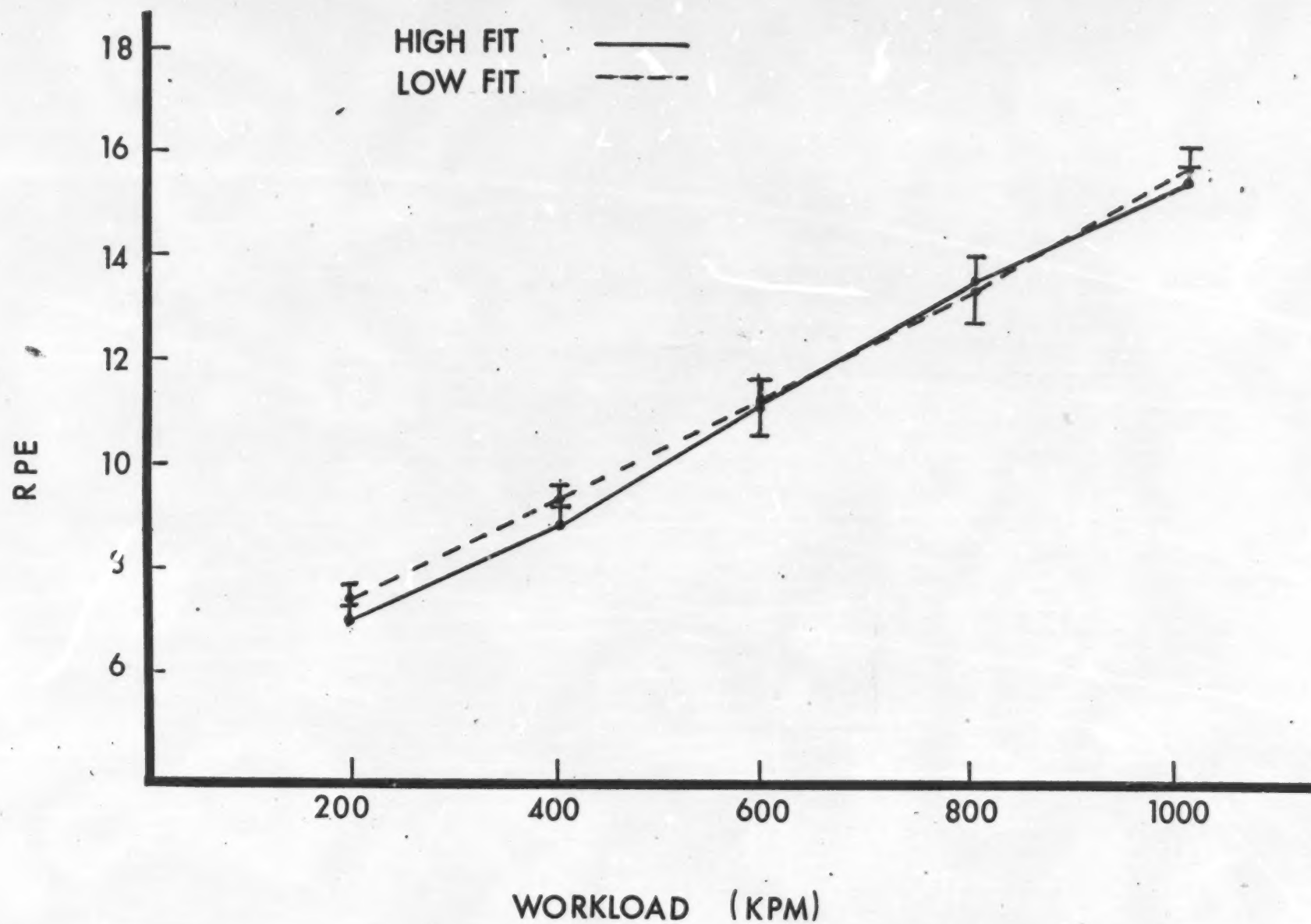


Figure 2. RPE at each submaximal workload for high and low fit subjects.

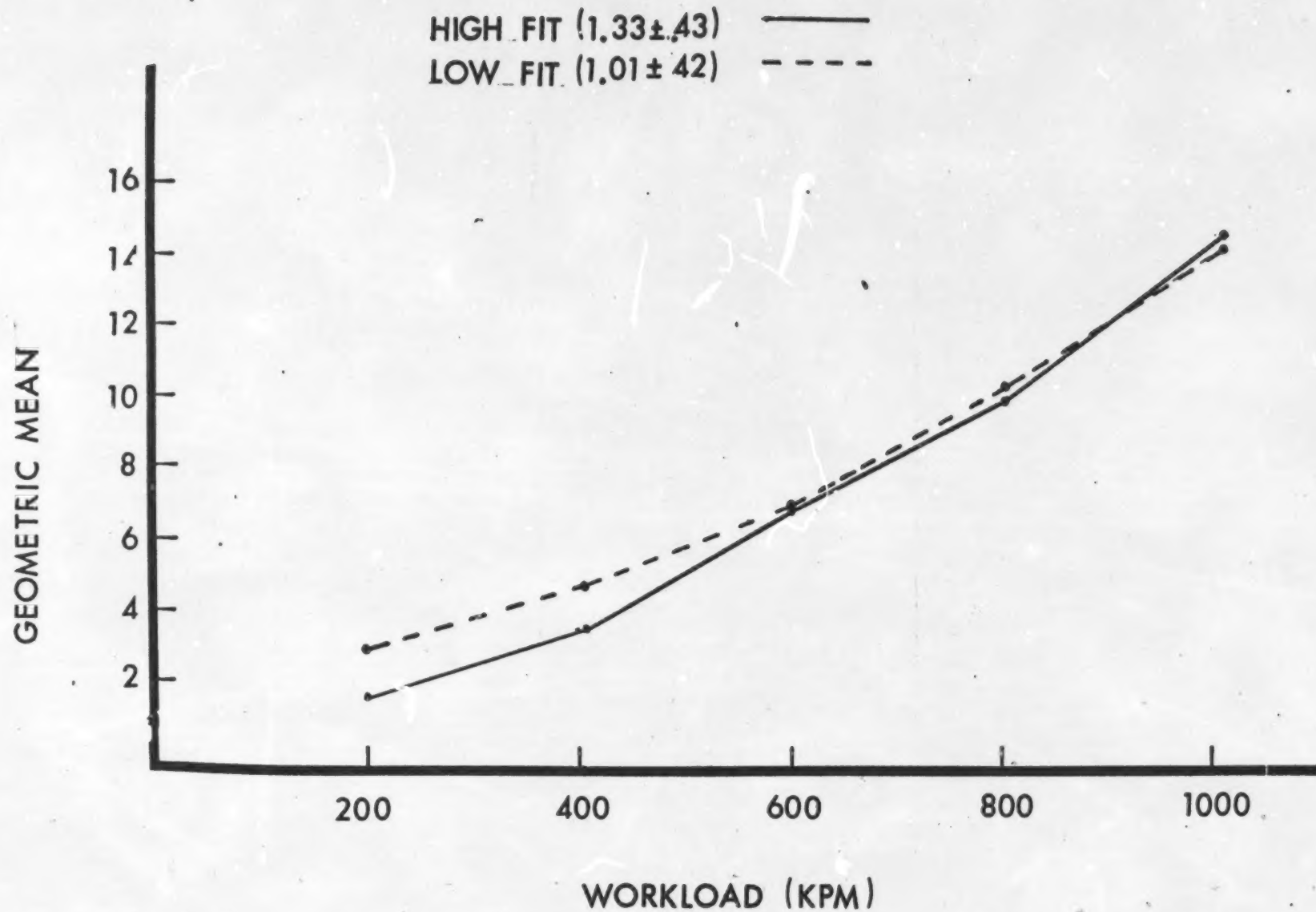


Figure 3. Psychophysical function based on the perceptual exponents for high and low fit subjects.

Table 1. Correlations between the perceptual exponent and selected psychological variables

<u>VARIABLE</u>	<u>HIGH FIT (N=19)</u>	<u>LOW FIT (N=17)</u>	<u>Z</u>	<u>p</u>
Extraversion	-.04	.56*	-1.84	ns
Neuroticism	.37	-.45	2.39	.05
Somatic Perception	.23	.10	0.37	ns
Trait Anxiety	.24	-.23	1.31	ns
State Anxiety	.44	-.35	2.29	.05
Tension	.57*	-.54*	3.42	.01
Depression	.37	-.56*	2.81	.01
Vigor	-.60**	.20	-2.45	.05
Fatigue	.19	-.07	-0.74	ns

* $p \leq .05$

** $p \leq .01$

Table 2. Multiple R and R^2 for prediction of the perceptual exponent from heart rate and selected psychological variables for the high fit group (N=19)

<u>VARIABLES</u>	<u>R</u>	<u>R²</u>
HR, V, T, N	.68	.46
HR, V, T	.66	.44*
HR, V, N	.64	.41*
HR, N, T	.58	.34
V, N, T	.67	.45*
HR, V	.60	.36*
V, T	.66	.44**
HR, T	.57	.32*
V, N	.64	.41*
HR, N	.38	.15
T, N	.59	.35*

* $p \leq .05$

** $p \leq .01$

Table 3. Multiple R and R^2 for prediction of the perceptual exponent from heart rate and selected psychological variables for the low fit group (N=17)

<u>VARIABLES</u>	<u>R</u>	<u>R²</u>
HR, E, N, T	.71	.50
HR, E, N	.60	.36
HR, E, T	.71	.50*
HR, N, T	.61	.37
E, N, T	.71	.50*
E, T	.71	.50**
E, N	.59	.35

* $p \leq .05$

** $p \leq .01$